Apache Focused Recapitalization Program

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Robert M. Cranwell
Sandia National Laboratories (SNL)
P.O. Box 5800
Albuquerque, NM 87185-1176

Phone: (505)844-8368 Fax: (505)844-3321
Email: rmcranw@sandia.gov

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AH-64 RECAP Program

Recapitalization (RECAP) Objectives:

Through upgrades and rebuilds of selected components and subsystems:

- **Achieve 20% Reduction in O&S costs**
- **Achieve 20% Increase in Availability**
- **Reduce average fleet life to 10 years by 2010**
- **Support Army's 90% Readiness Goal**

Improve Apache Warfighting Capability!

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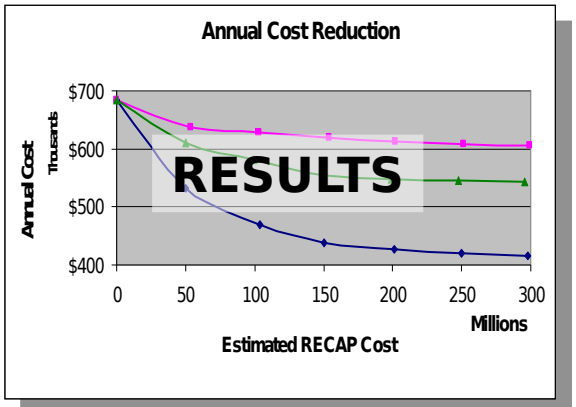
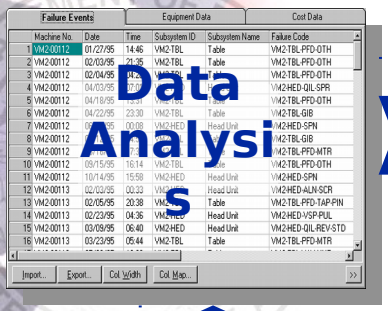
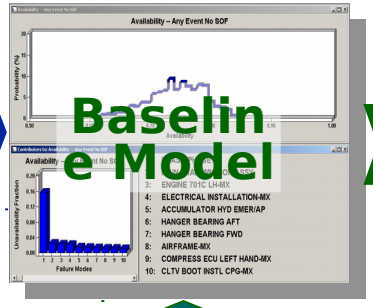
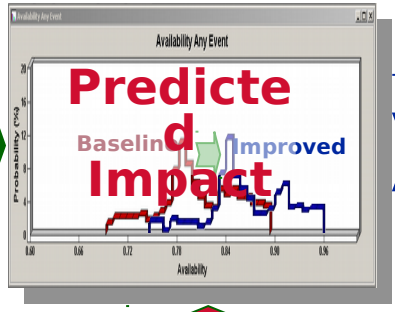
Modeling & Analysis Approach

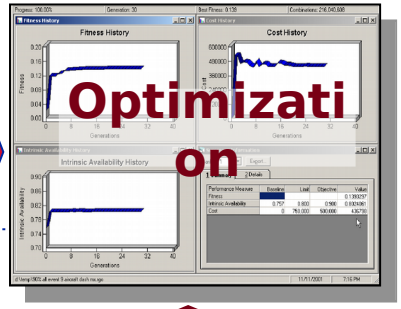
- **Model Apache System**
  - Populate with existing failure & maintenance data
  - Analyze & compare against current system performance
- **Predict Impacts of Planned RECAP Items**
  - Predict impacts of current planned RECAP components & subsystems
  - Evaluate other cost and availability drivers identified by the baseline model
- **Optimize RECAP Plan ("best bang for the buck")**
  - Minimize annual cost
  - Maximize aircraft availability











Maintenance Data

- AMSAA's SDC data
- Phase/inspection data

MTBF Update

- 2410 tracked parts
- LM's TADS/PNVS data

Reliability Targets

- MTBF goals
- Associated costs

Objectives & Constraints

- Performance objectives
- Cost constraints

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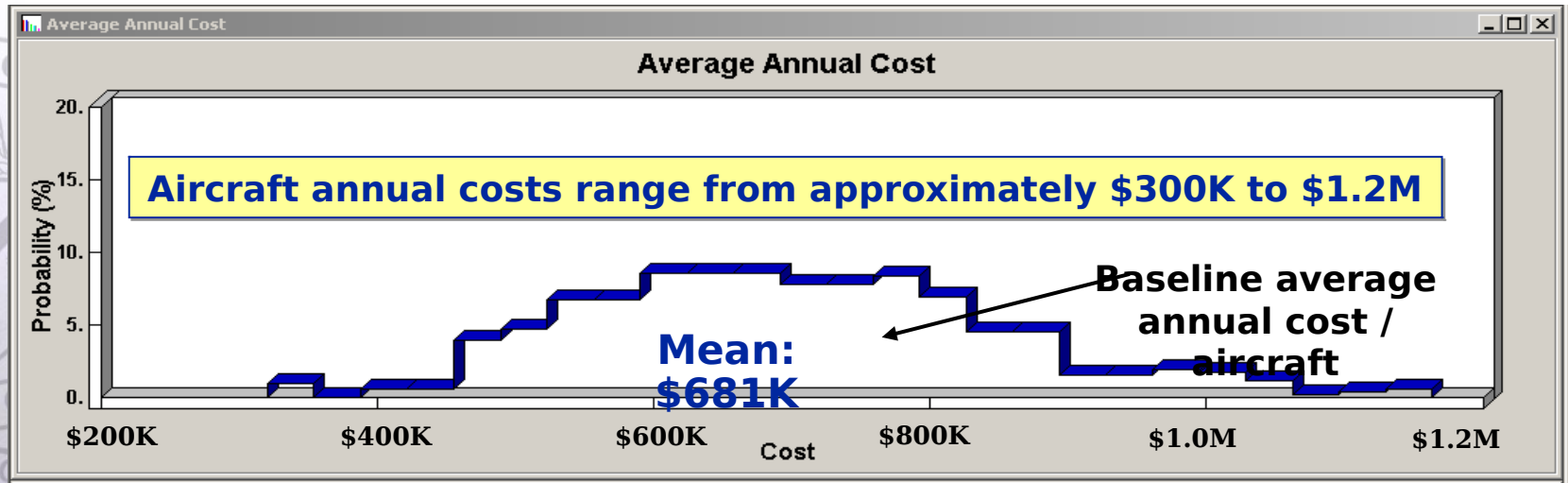
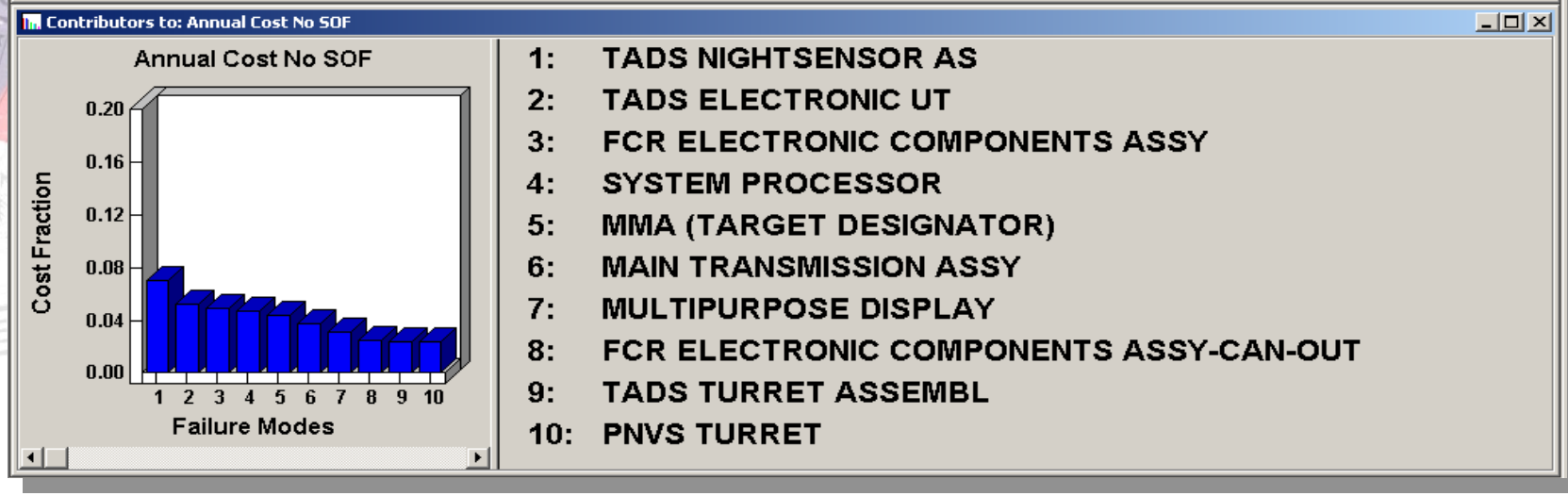
Example Baseline Model Results





Annual cost driven by TADS and FCR

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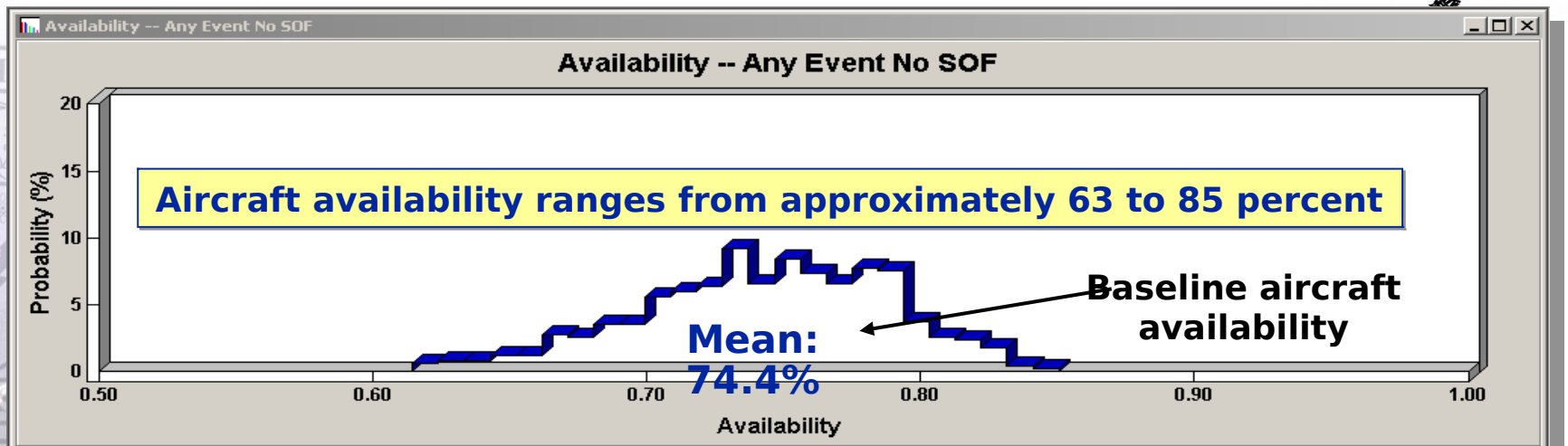
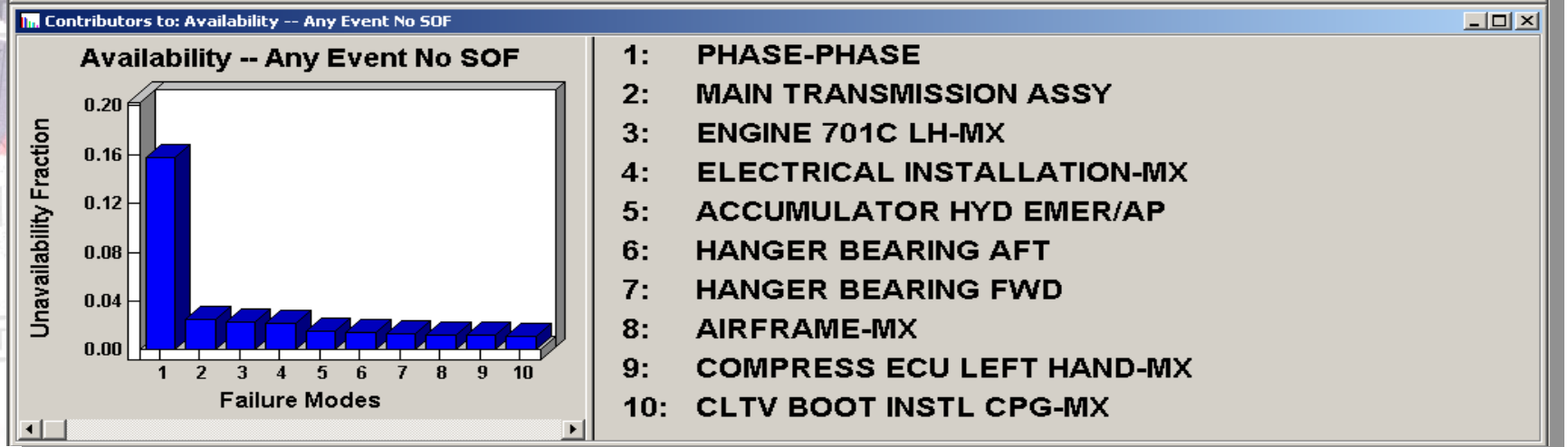
Example Baseline Model Results





Aircraft availability driven by phase maintenance & drive train components

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Example Baseline Model Results

AH-64 System Modeling identified 39 cost & availability drivers not included in original 52 RECAP items

- **Selection Criteria for Original 52 RECAP Items**
  - ❖ Average Monthly Demand
  - O&S Cost Drivers
  - Readiness Drivers
- **Analysis Took a "Systems" Approach**

Failure Modes
ENGINE 701C RH
FLIGHT MANAGEMENT CMPTR
HANGER BEARING AFT
COMPRESS ECU LEFT HAND
SHAFT ASSY COMM
HANGER BEARING FWD
NOZ ASSY, PRIMARY LH
. . .

"... a day in the life of an Apache"

A systems approach assesses key readiness drivers

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Reliability Improvement Targets

Reliability Targets:

- 1500 hr MTBF dynamic parts
- 2500 hr MTBF structural & electronic
- Else, 20% increase above observed MTBF

Component	Part Cost	Observed MTBF	Target MTBF	% MTBF Improvement	Estimated Cost
PNVS AZIMUTH DRIVE GIMBALS	$16,956	2103	2524	20%	$4.2M
GEARBOX, TAIL ROTOR	$34,628	929	1500	62%	$4.6M
SHOCK STRUT ASSY (MLG)	$14,597	3332	3998	20%	$5.0M
LASER TRANCEIVER UNIT	$79,026	1054	2500	137%	$3.5M
HEAD, ROTARY WING (MR)	$184,553	1982	2378	20%	$35.6M
TRANSMISSION, MAIN	$281,604	1137	1500	32%	$27.0M
HANGER BEARING AFT	$6,053	568	1500	164%	$1.1M
APU CLUTCH	$25,582	219	1500	585%	$2.0M
MAIN ROTOR BLADE	$81,889	1352	1622	20%	$21.1M
…	…	…	…	…	…

Optimization analyses are applied to find "best" solution

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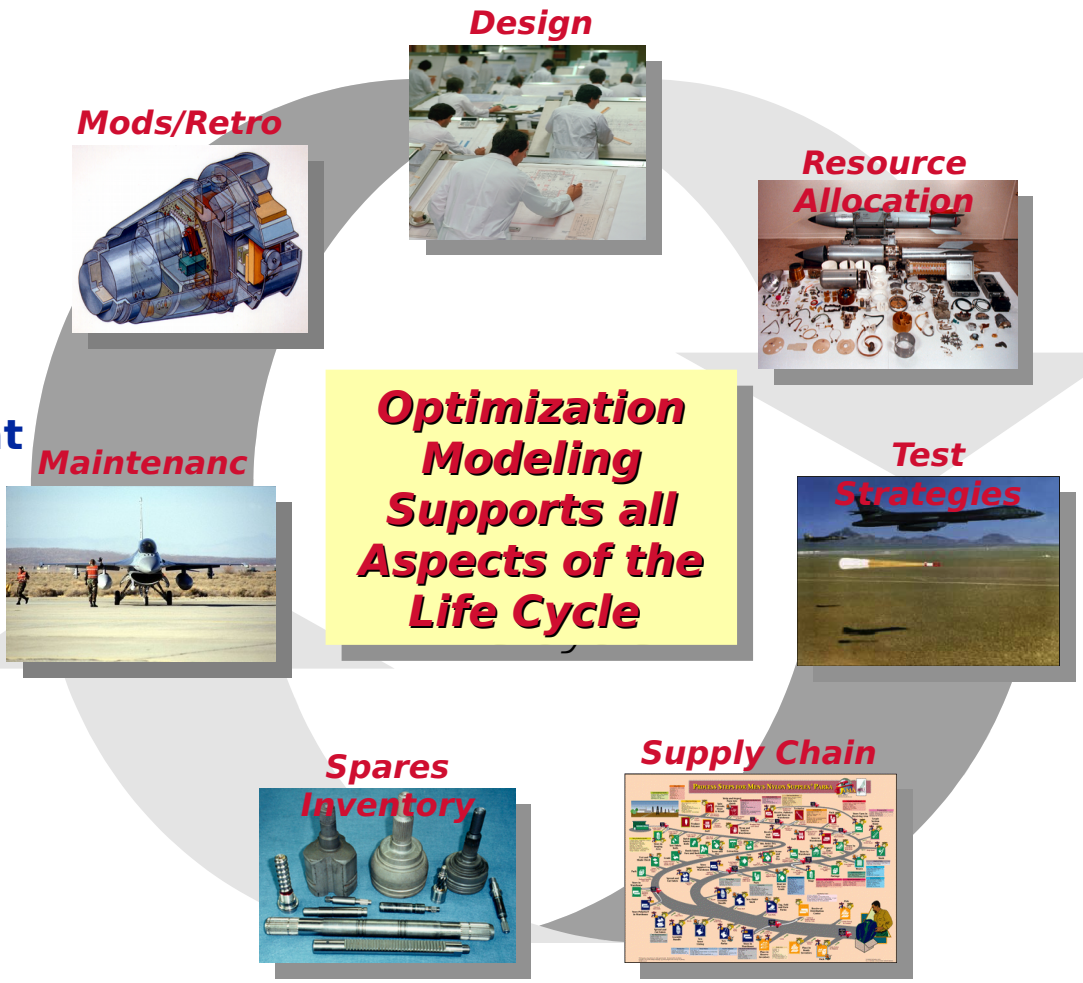
Optimization Modeling

Optimization:

- ***Objectives:*** **What is being targeted?**
  - Increased availability
  - Reduced costs
  - Reduced weight
  - .
  - .
  - .
- ***Improvement Options:*** **What can be done to meet objectives?**
  - Redesign
  - Technology insertion
  - Improved reliability
  - .
  - .
  - .
- ***Constraints:*** **What are constraints to work within?**
  - Cost/budget
  - Volume/weight
  - Time
  - .
  - .
  - .



The purpose of optimization is to find the combination of *improvement options* which will satisfy the *constraints* and fulfill the *objectives.*

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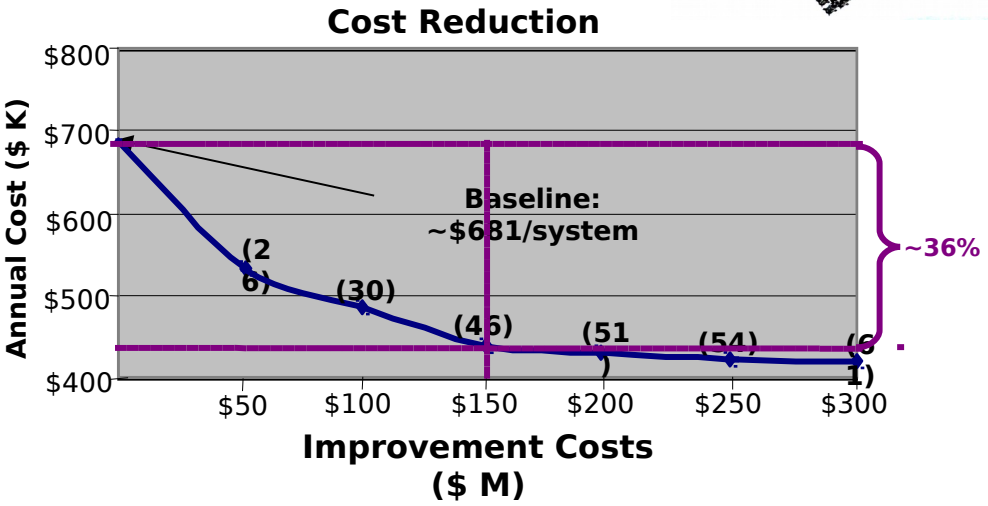
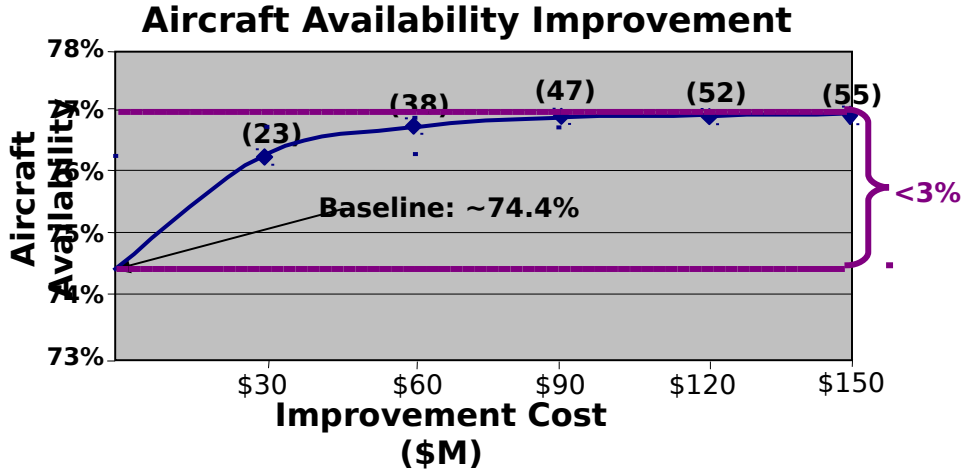
Optimization Analyses

- **Objectives:**
  - 20% reduction in annual costs
  - 20% improvement in availability
- **Improvement Options:**
  - Improve reliability of 91 items
    - 1500 hrs MTBF – dynamic
    - 2500 hrs MTBF – other
    - 20 % minimum
- **Constraint:**
  - Keep cost of improvements at minimum

Note: Cost to improve reliability of all 91 items ~$560M





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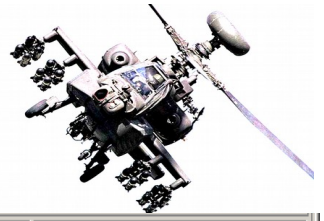
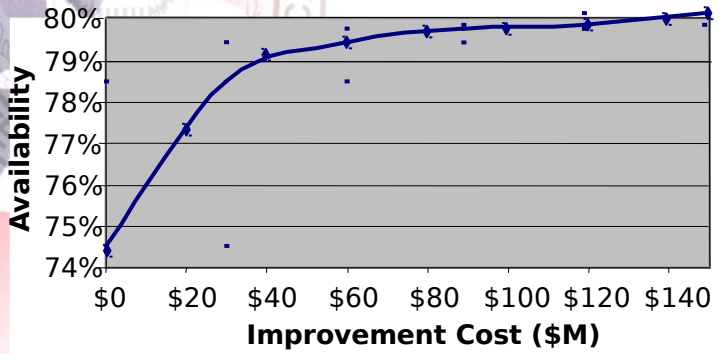
Optimal Resource Allocation



- **Objectives:**
  - 20% reduction in annual costs
  - 20% improvement in availability
- **Improvement options: Improve reliability of top availability and cost drivers**
  - Example:
    - Level 0 = no improvement
    - Level 1 = 20% improvement
    - Level 2 = 40% improvement
    - Level 3 = 60% improvement
    - Level 4 = 80% improvement
    - Level 5 = 100% improvement
- **Constraint: Improvement costs**



Progress: 100.00% | Generation: 200 | Best Fitness: 0.643 | Combinations: 1.773123E+55

Rank: 1 Export...

1 Summary | 2 Details

Allocation at $20M

Option	Level	Cost
PNVS Azimuth Drive Gimbals	4	3.20
PNVS ELECTRONIC UNIT	5	5.00
PNVS TURRET	5	5.00
POWER SUPPLY	1	64,000.00
PROCESSOR,SIGNAL (FAULT FUNC)	1	64,000.00
PUMP, HYDRAULIC RAM (GRND SERV)	0	0.00
PUMP,AXIAL PISTONS, (L&R HYD)	2	256,000.00
PUMP,SUBMERGED, (REFUEL XSFR)	0	0.00
PYLON, AIRCRAFT (4)	2	256,000.00
RADAR ALTIMETER R/T	1	64,000.00
RECEIVER-TRANSMITTER	3	576,000.00
SCISSORS ASSY MAIN ROTOR UPPER CONTROL SECONDARY	1	64,000.00
SERVOCYLINDER (COLL. CONT.) (1 ea)	0	0.00
SERVOCYLINDER (DIR. CONT.) (2 ea)	4	1,024,000.00
SERVOCYLINDER (LAT. CONT.) (1ea)	3	576,000.00
SHAFT ASSY COMM	1	64,000.00
SHOCK STRUT ASSY (MLG) (2 EA)	2	256,000.00
SHOCK STRUT ASSY (TLG) (1 EA)	1	64,000.00
SWASHPLATE,CONTROL (T/R)	1	64,000.00
SWASHPLATE,CONTROL, (M/R)	0	0.00
TADS ELECTRONICS UNIT	5	5.00
TADS POWER SUPPLY	5	5.00
TADS SERVO ELEC/TORQ AMP	5	5.00
TADS TURRET	5	5.00
TAIL ROTOR FORK ASSY	1	64,000.00
TRAIN RATE SENSOR	2	256,000.00

The results show where optimally to spend your dollars & effort

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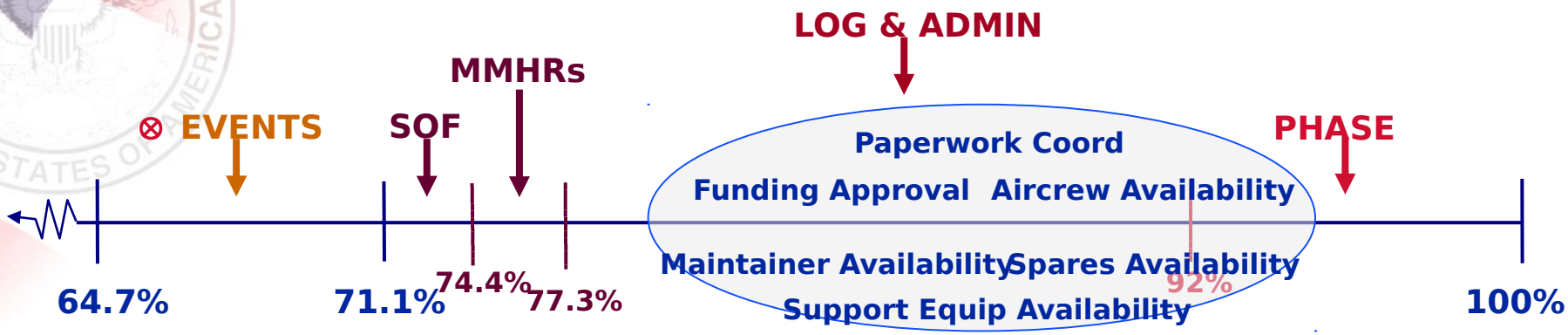
Multiple Improvement Options

- **Three improvement options (where applicable)**
  - Spares – Increase the number of spares on hand
    - Example: Having a spare lowers downtime by 50%
  - Labor – Increase the number of maintenance personnel
    - Example: An additional maintainer lowers downtime by 25%
  - Failure Rate – Increase in the time between events
    - Example: An improved parts fails 25% less often



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Summary

Benefits of Analysis

- **Cost and Availability Impacts**
  - Analyses can save over 50% of expected RECAP investment cost
  - RECAP items increase availability only ~3%
- **Use Model to Evaluate "What If's"**
  - What will it take to get to Army Aviation's 90% readiness goal?
    - RECAP alone will only get less than 3% improvement
    - Optimal combination of component reliability, phase, log & admin, etc.

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Apache – It's The Law!